## ABSTRACT OF THE DISCLOSURE

A control system in the form of an all-digital phase-locked loop controls movement of a DC motor. The control system includes a movement detector in the form of an optical encoder to detect movement of a DC motor. A digital phase detector compares output of a feedback signal from the movement detector and a reference signal. The digital phase detector is phase frequency detector that follows a describing function to model non-linear components of the reference signal. A digital loop filter then filters noise from the comparison signal and the filtered signal is amplified to control the DC motor. The phase frequency detector includes a state machine to track a time varying reference signal and selectively output a response to provide for system damping.